Respiration in Humans:

Purpose of respiration:
Break down glucose and release the energy within.

Oxygen and glucose are needed for this process to happen.

The idea of a system for respiration is to allow for efficient cellular respiration for oxygen to enter the body. It allows us to take in oxygen and give out carbon dioxide. This is known as gaseous exchange.
Parts:

a. Lungs
b. Nose
    i. the nostrils contain hairs that trap large particles of dust or dirt.
c. Larynx
d. Trachea (windpipe)
    i. Contains gland cells that secrete mucus to trap dust particles and bacteria
    ii. Lined with ciliated epithelium which sweep foreign particles and bacteria up the trachea and into the nostrils.
    iii. Cilia are hairlike structures. They are NOT microvilli as there is no absorption involved. They also sweep up mucus with the foreign particles and bacteria.
    iv. When inflamed/swollen, the passageway for air becomes narrower. Less air is able to enter or pass through to the lungs and in severe cases, can suffocate to death. It leads to reduced gaseous exchange. Less O2 for respiration, less energy blah blah blah.
e. Bronchi (singular: bronchus)
    i. When inflamed/swollen, the passageway for air becomes narrower. Less air is able to enter or pass through to the lungs and in severe cases, can suffocate to death. It leads to reduced gaseous exchange.
f. Bronchioles
g. Alveoli (singular: alveolus) (mostly tested on 4 adaptations)
    i. To be clear, the adaptation must be linked to the function. The function is to facilitate gaseous exchange, with relies on diffusion.
    ii. This is where gaseous exchange occurs. The **wall** of the alveoli are one cell thick to have a shorter **diffusion** distance so that gaseous exchange will be more efficient.
    iii. ***Continuous blood flow*** around the alveoli allows for the maintenance of a ***steep concentration gradient***. The red blood cells exchange carbon dioxide for oxygen in the alveoli.

iv. There is also a rich network of capillaries around the alveoli to provide a large surface area for diffusion to occur. Additionally, the numerous alveoli in the lungs increases the ***surface area to volume ratio*** for diffusion to occur during gaseous exchange, hence increasing the rate of ***diffusion during gaseous exchange*** (of O2 and CO2)
v. The alveoli has an alveolar cavity, where air enters and exits.
vi. There is a **thin film of moisture** ***lining the inner walls of an alveolus.*** This allows oxygen to dissolve for diffusion before being absorbed into the bloodstream.

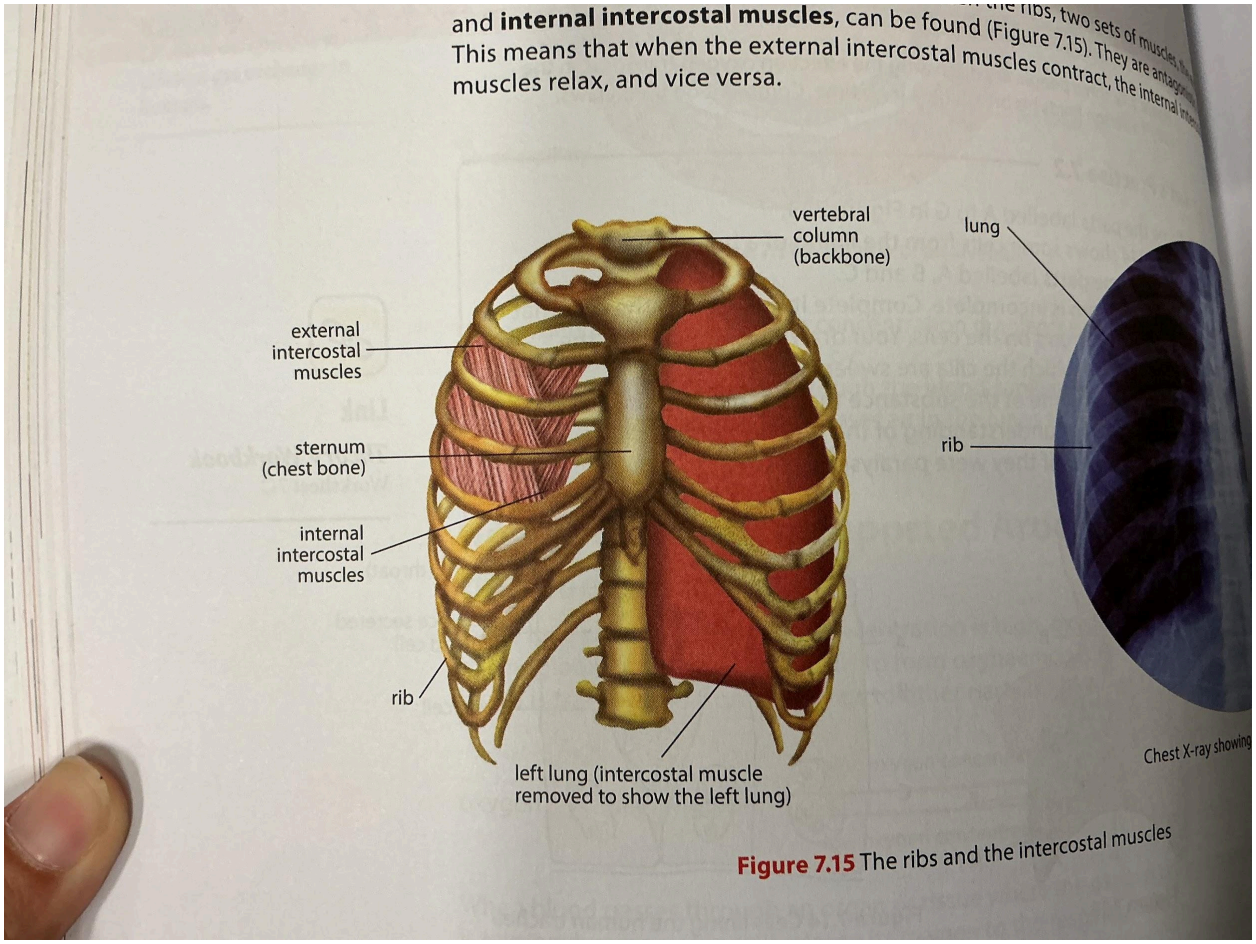
h. Diaphragm (MY GOAT IN VOCALS)
   i. A thick, dense piece of muscle located at the bottom of the ribcage
   ii. Only job is to contract and relax
   iii. When it contracts, it flattens itself (goes down) and creates a vacuum to force air into the lungs.
   iv. When it relaxes, it arches up (goes up) and forces air out of the lungs.
i. intercostal muscles (ALSO MY VOCALS GOAT)
   i. external intercostal muscles are pointing away from the lungs
   ii. internal intercostal muscles are pointing towards the lungs

YOU CANNOT HAVE AN AIR BUBBLE IN YOUR BLOOD OR ELSE YOU DIE A VERY PAINFUL DEATH.

Other terms:

1. Thorax

(TB pg 140. Annotated irl)



- Sometimes referred to as the thoracic cavity, it **does not** apply to trachea.
- The chest wall is supported by the ribs. Between the ribs, two sets of muscles, the external and internal intercostal muscles, can be found. Once again, they are antagonistic muscles.
- Taking in air: inhalation/inspiration. Releasing air: exhalation/expiration
- Sternum (moveable) can move in breathing, but your backbone (fixed) will not move.

2. Inhaling and Exhaling also helps to maintain a steep concentration gradient.

<u>Inhalation</u>:
annotated on pg 141
note that with intercostal muscles, you have to talk about ribs immediately

The thorax is separated from the abdominal cavity by a dome-shaped sheet called the **diaphragm**. The diaphragm is made of muscle and elastic tissue. When the diaphragm muscles contract, the diaphragm flattens downwards, and when they relax, the diaphragm arches upwards again. The workings of the intercostal muscles and the diaphragm change the volume of the thoracic cavity (Figures 7.16 and 7.19).

Inspiration (Inhalation)

Note that the words 'upwards' and 'downwards' are used with reference to a person standing in the upright position.

When you inspire, the following events take place:

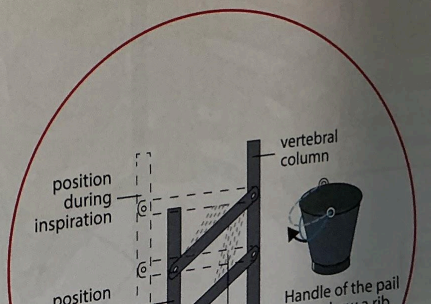
- Your diaphragm muscle contracts, and the diaphragm flattens.
- Your external intercostal muscles contract while your internal intercostal muscles relax.
- Your ribs move upwards and outwards. Your sternum also moves up and forward.
- The volume of your thoracic cavity increases.
- Your lungs expand and air pressure inside them decreases as the volume increases.
- Atmospheric pressure is now higher than the pressure within your lungs.
- Air moves into the lungs.

Link

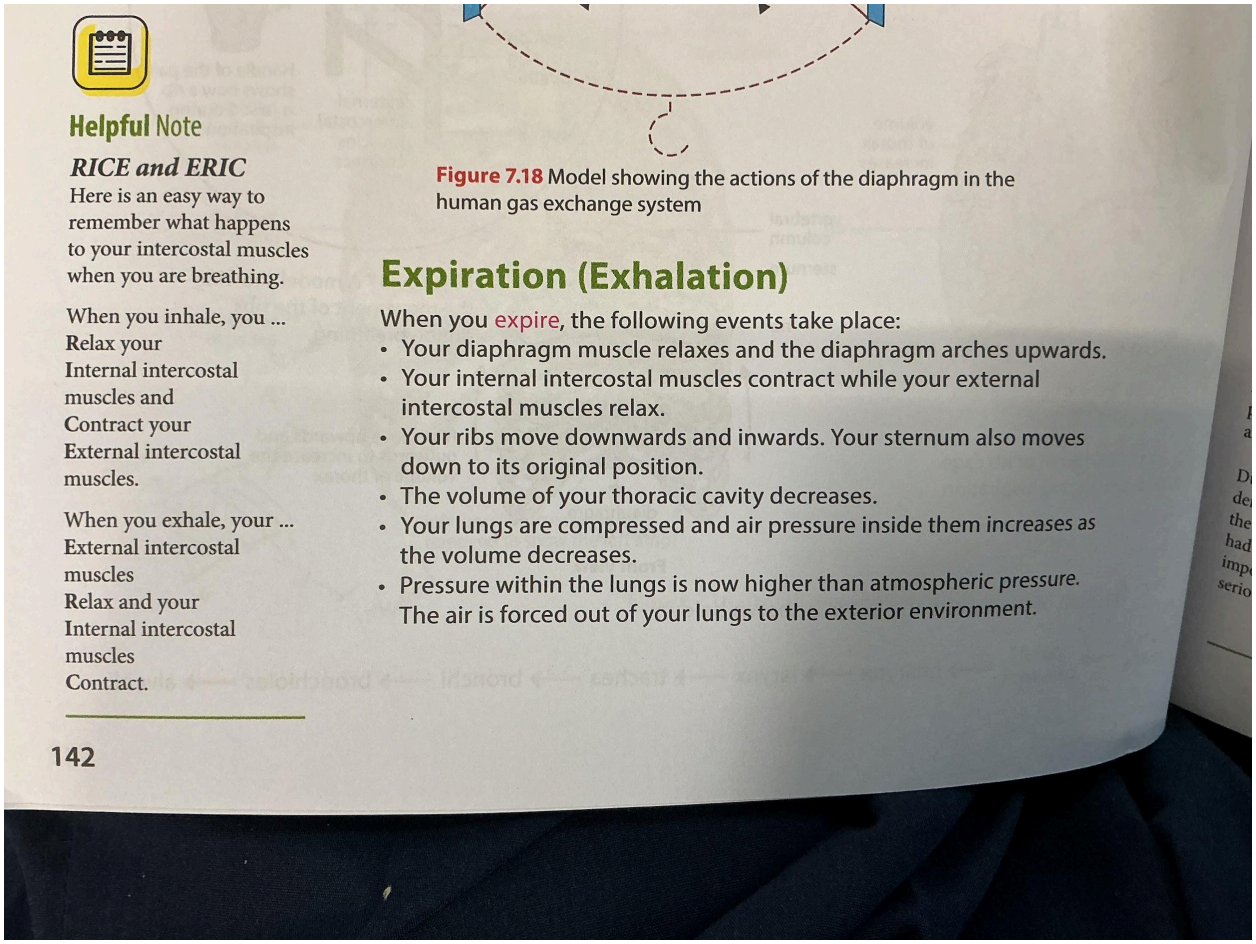
Refer to Figure 7.8 in Section 7.2 to recall the position of the thorax

Word Alert

Inspire: Inhale, breathe in



air forced into lungs due to increase in volume of lungs



Helpful Note

RICE and ERIC

Here is an easy way to remember what happens to your intercostal muscles when you are breathing.

When you inhale, you ...
Relax your
Internal intercostal muscles and
Contract your
External intercostal muscles.

When you exhale, your ...
External intercostal muscles
Relax and your
Internal intercostal muscles
Contract.

Figure 7.18 Model showing the actions of the diaphragm in the human gas exchange system

Expiration (Exhalation)

When you expire, the following events take place:

- Your diaphragm muscle relaxes and the diaphragm arches upwards.
- Your internal intercostal muscles contract while your external intercostal muscles relax.
- Your ribs move downwards and inwards. Your sternum also moves down to its original position.
- The volume of your thoracic cavity decreases.
- Your lungs are compressed and air pressure inside them increases as the volume decreases.
- Pressure within the lungs is now higher than atmospheric pressure. The air is forced out of your lungs to the exterior environment.

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Other stuff idk where this goes:

- breathing occurs without conscious effort (reflex action, see: nervous system)
- ribcage moves upwards and outwards (when standing upright)
- Causes volume of thoracic cavity to increase
- causing air to suck into the lungs
- exhaling, diaphragm moves upwards and outwards
- ribcage moves downwards and inwards
- ribcage can only perform one set of moves at a time, hence cannot breath in and out at the same time.

Cigarettes, **tobacco smoke**, and the lungs:
Nicotine:

- causes addiction
- increases heart rate and blood pressure
- Increases the risk of blood clots in the arteries, which leads to an increased risk of coronary heart disease
    - Since the blood clots block the lumens of arteries, it prevent blood from flowing back to the heart.

- Increases the risk of narrowing arteries
    - In a pregnant mother, narrow arteries decrease the amount of food substances reaching the fetus, thereby affecting fetal development and may cause miscarriage

Tar:

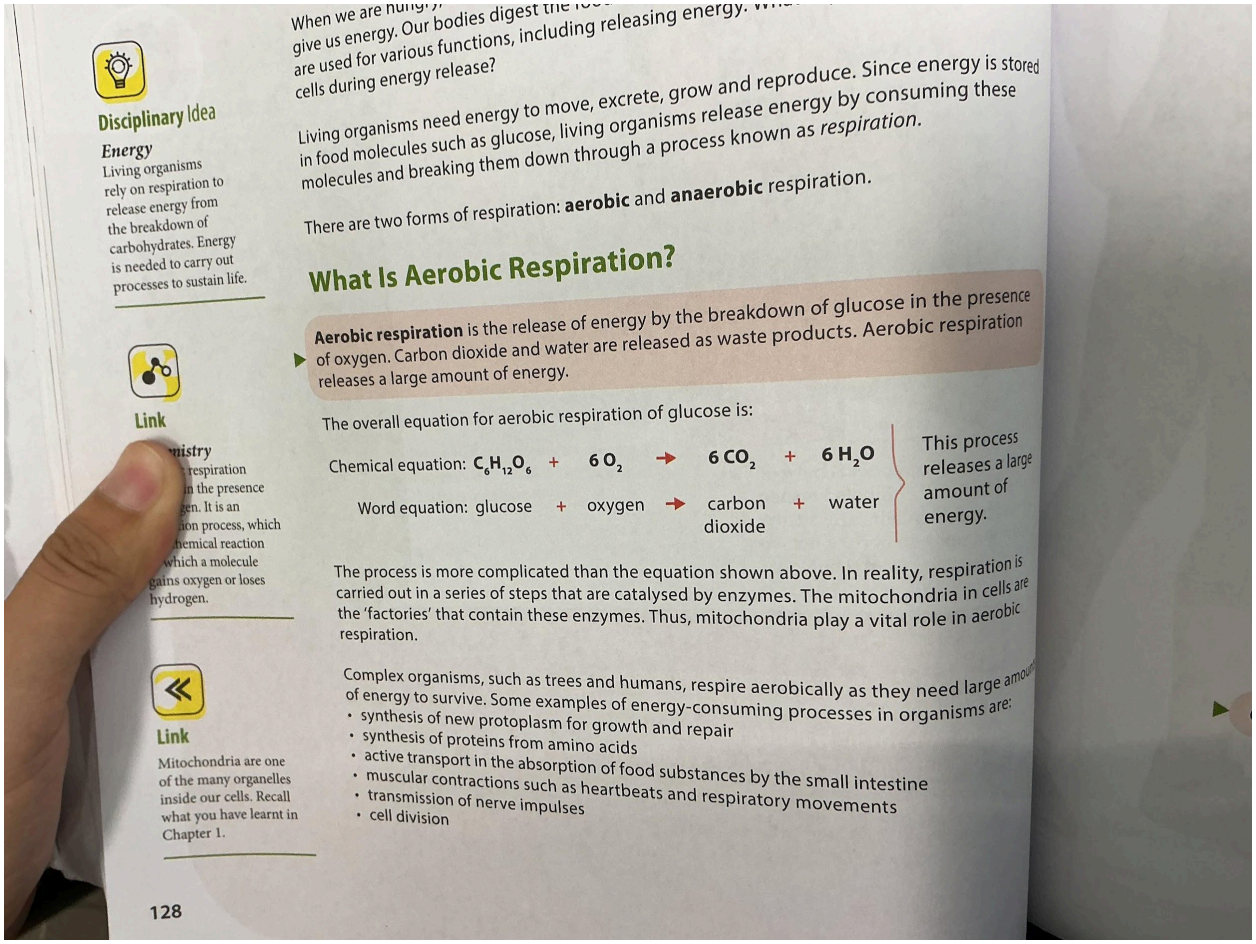
- increases risk of lung cancer (how?)
    - Tar can cause uncontrolled cell division
- Increases risk of chronic bronchitis and emphysema
    - Emphysema is a chronic and progressive condition. It leads to the partition walls between the alveoli breaking down due to the persistent and violent coughing. The lungs also lose their elasticity (cannot revert back to normal shape) and become inflated with air. Breathing becomes very difficult. Wheezing and severe breathlessness are a result.
- Increases the risk of chronic bronchitis after coughing so much. In chronic bronchitis:
    - Lining of air passages become inflamed
    - Excessive mucus is secreted by the epithelium
    - Cilia on epithelium are paralysed, so mucus, bacteria and dust particles cannot be removed.
    - Air passages become blocked, which make breathing difficult.
    - In an effort to breathe, persistent coughing will occur to clear air passages, which increases the risk of getting lung infections.
- Tar paralyses the cilia lining the air passages. Hence, dust particles trapped in the mucus lining cannot be removed.

Carbon Monoxide:

- It binds to haemoglobin irreversibly, reducing the amount of haemoglobin readily available to transport oxygen and reducing the amount of oxygen available for body cells
    - In a pregnant mother, less oxygen reaches the fetus through the placenta which may affect fetal development

Aerobic Respiration:

Definition: The ***release*** of energy by the breakdown of glucose in the presence of oxygen. Carbon Dioxide and water are released as waste products. Aerobic Respiration releases a large amount of energy.



When we are hungry, ... give us energy. Our bodies digest the food ... are used for various functions, including releasing energy. What ... cells during energy release?

Living organisms need energy to move, excrete, grow and reproduce. Since energy is stored in food molecules such as glucose, living organisms release energy by consuming these molecules and breaking them down through a process known as *respiration*.

There are two forms of respiration: **aerobic** and **anaerobic** respiration.

Disciplinary Idea

Energy

Living organisms rely on respiration to release energy from the breakdown of carbohydrates. Energy is needed to carry out processes to sustain life.

What Is Aerobic Respiration?

Aerobic respiration is the release of energy by the breakdown of glucose in the presence of oxygen. Carbon dioxide and water are released as waste products. Aerobic respiration releases a large amount of energy.

Link

...mistry

...respiration ...in the presence ...gen. It is an ...ion process, which ...hemical reaction ...which a molecule gains oxygen or loses hydrogen.

The overall equation for aerobic respiration of glucose is:

Chemical equation: $C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O$

Word equation: glucose + oxygen → carbon dioxide + water

This process releases a large amount of energy.

The process is more complicated than the equation shown above. In reality, respiration is carried out in a series of steps that are catalysed by enzymes. The mitochondria in cells are the 'factories' that contain these enzymes. Thus, mitochondria play a vital role in aerobic respiration.

Link

Mitochondria are one of the many organelles inside our cells. Recall what you have learnt in Chapter 1.

Complex organisms, such as trees and humans, respire aerobically as they need large amounts of energy to survive. Some examples of energy-consuming processes in organisms are:

- synthesis of new protoplasm for growth and repair
- synthesis of proteins from amino acids
- active transport in the absorption of food substances by the small intestine
- muscular contractions such as heartbeats and respiratory movements
- transmission of nerve impulses
- cell division

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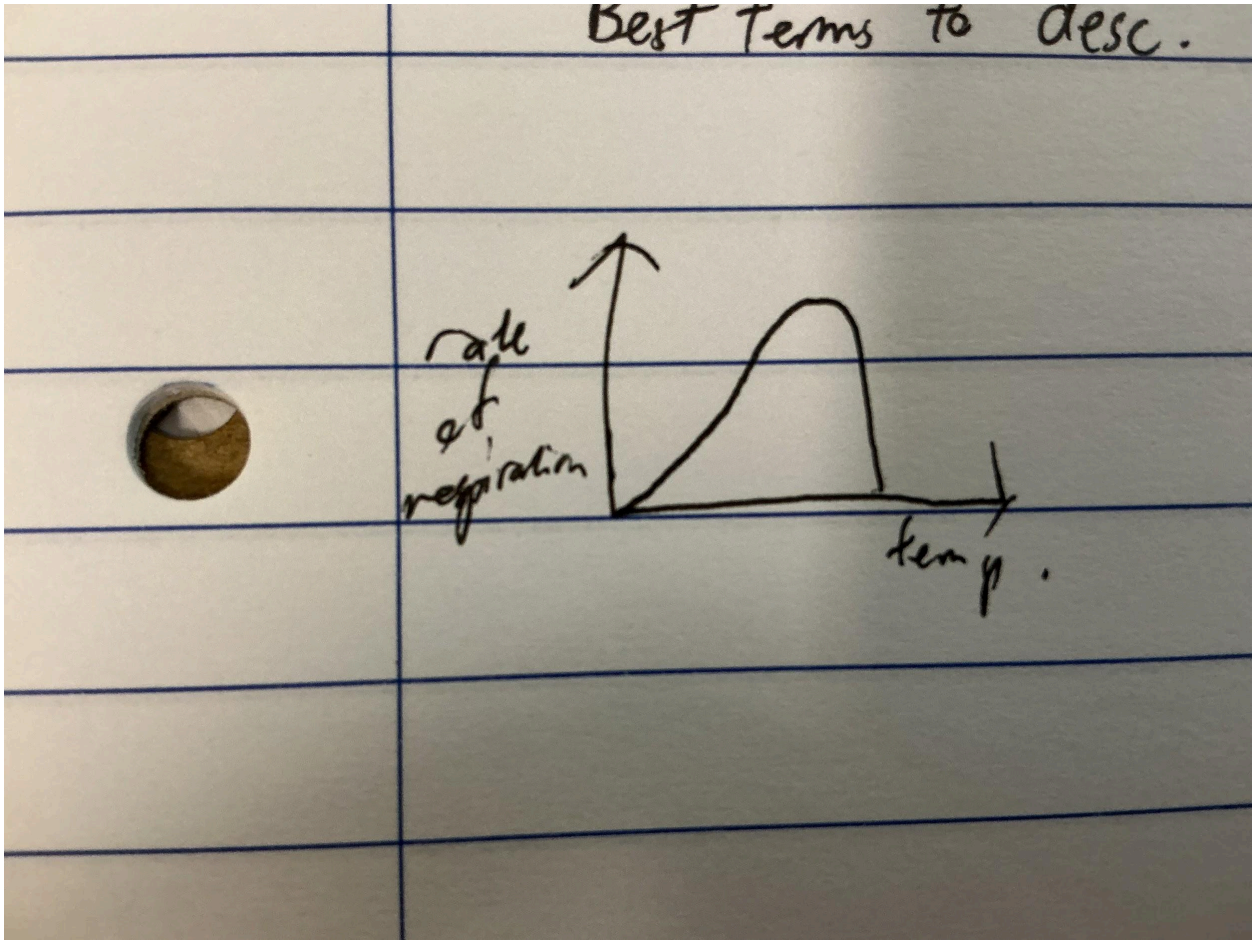
(i'm bumming out man i'm bored)

Energy is not present in the equation as it is not a chemical. It is found in the bonds between elements/molecules, and is released when the bonds are broken. This takes place in a cell, specifically the mitochondria.

Rate of Respiration



The rate of respiration is affected by:

a. Temperature
    i. Respiration relies on enzymes, hence go check your enzymes notes
b. Energy Demand
    i. During exercise/physical activity, muscular contractions increase. This causes energy demand to go up as energy is used in muscular contraction, which affects rate of respiration.
c. To increase aerobic respiration, one can increase the depth and rate at which they breathe.
    i. This will help to supply more oxygen to the body. (but this only works in lungs.
    ii. An increase in the heart rate would lead to an increase in the transport of blood to the muscles, supplying more glucose AND more oxygen to the muscle cells.

<u>Anaerobic Respiration</u>

Definition: Respiration that takes place without the presence of oxygen.
Formula: glucose -> lactic acid
Releases a little bit of energy.

More lactic acid incurs oxygen debt, which is basically amount of oxygen needed to “pay back” the debt and break down lactic acid.